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User's Guide

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1. INTRODUCTION

This report describes the use of a terminal connected to a Terminal IMP (TIP) in the ARPA Network. The report assumes that the user knows how to operate a server Host system somewhere on the network once he becomes connected to that system, and the report defines the procedures and options the user has available to establish that connection.

The ARPA Network, IMPs and TIPs, hardware maintenance, TIP operation, and formats and protocols are not described here. The bibliography (Appendix C) lists the relevant documents.

At the time of this writing we at Bolt Beranek and Newman Inc. (BBN) have operated the TIP extensively with the following terminal types:

KSR-33 Teletype
KSR-37 Teletype
IBM-2741 (Correspondence)*
IBM-2741 (P.T.T.C.)*
DATA 100 (at 110, 150, 300, 600, and 1200 bps)
EXECUPORT (at 110, 150, and 300 bps)
INFOTON VISTAR I (at 110, 150, 300, 600, 1200, 1800, 2400, and 9600 bps)
IMLAC PDS-1 (at 1800, 9600 bps, and synchronous)
ODEC 132 LINE PRINTER
TELETYPE INKTRONICS (Line printer)
TI 733
TELERAY
ANDERSON-JACOBS 832
DECWRITER II
DATA PRODUCTS LINE PRINTER MODEL 2410 or 2411

Where possible, all these devices have been operated with direct connections to the TIP and also over a 103A dial-up modem.

We have also briefly operated the TIP or heard of the TIP being operated with a variety of other types of terminals. These are listed in Appendix D. For your own safety, before you purchase any terminal listed in Appendix D or any other terminal for use with the TIP, you should check with BBN and try it with a TIP.

One TIP is configured with a magnetic tape drive which is used as discussed in Section 8.

It should be noted that the TIP is designed to support interactive, asynchronous terminals. It cannot normally support synchronous devices, or devices whose input (to the TIP) characteristics are significantly different from a human typist. Thus

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*For a 2741 to operate with the TIP, the 2741 must have the transmit interrupt option and receive interrupt option.

the connection of computers, paper tape readers, polled circuits, buffered terminals, and so on to TIP ports is likely to be difficult or impossible.

2. THE NETWORK VIRTUAL TERMINAL

A key concept in the use of the network is the notion of the virtual terminal. Instead of asking each Host system to cope with every terminal type at every other Host in the network, we ask the Host to cope with a single (imaginary) terminal called the Network Virtual Terminal. Your TIP will translate the data you type to make it look like virtual terminal code, and translate the remote system's response back into your terminal's code. While we will often pretend that this translation does not exist, it is, in fact, always present and of crucial importance to the user.

It is probable that the manual describing the use of the remote system is written in terms of a user at the virtual terminal, most likely as a system description based on local terminals plus an add-on piece telling how to use the virtual terminal as a local terminal. Virtual terminal code may include symbols which do not exist on your own keyboard. Combinations of your available characters are used in such cases. You may even find that the translation makes your terminal different from a local terminal of the same make. We have tried to minimize this problem.

The Network Virtual Terminal has 128 keys, often in upper case/lower case pairs. These keys correspond to the full ASCII set. In addition, there are a few control keys, like the "BREAK" key. The terminal is capable of full and half duplex operation, under control of a user-oriented switch. The meaning of the control keys and the way to enter the full 128 keys from each of the terminal types which the TIP supports is described in Section 6 of this report.

The user talks to the TIP after the code conversion has been made; that is, the TIP expects virtual terminal characters. The descriptions below are in terms of virtual terminal codes.

3. THE TIP COMMAND FORMAT

The user at a terminal will at various times be talking directly to his TIP instead of to the remote Host. A typical message of this sort might look like:

@ OPEN 15

Such a command always starts with symbol @ and ends with either a linefeed* or a rubout, depending on whether the user is satisfied with the command or wishes to abort it. The only exception to this rule is the specific command

@@

which inserts an @ in the data stream to the Host. Commands may occur anywhere, and need not start on a new line. Upper and lower case may be freely intermixed in the command.

Between the @ and the linefeed there will typically be one or more words to identify the command, perhaps followed by a single parameter. The TIP is not very sophisticated, and thinks the only important thing about a word is its first letter. This permits the user to abbreviate a bit; the more usual rendering of the first example might be:

@O 15

Once the user has started typing the parameter of a command the old value of the command will have been destroyed, and cannot be recovered by aborting the command.

Almost without exception the effect of a TIP command is to set a parameter or mode for the terminal. Even apparently direct commands like

@ OPEN 15

(which initiates an elaborate exchange of messages resulting in a connection to the remote Host system) actually set a mode flag to request the appropriate action when the TIP is free to undertake it. To understand the TIP behavior is really to understand the complete set of parameters and the commands to change them. Normally, any parameter can be changed at any time by the user at his terminal. Exceptions occur when the user tries to change connection parameters

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*On 2741 terminals the return key transmits carriage-return/ linefeed to the TIP and ASCII terminals are normally operated in a mode where typing a carriage-return is interpreted as carriage-return/linefeed; both can be used to terminate TIP commands in addition to a linefeed alone.

on an open connection. An @OPEN 13 executed while talking to Host 15 would generate the error message "Can't" (the connection to Host 15 must be closed before a connection can be opened to Host 13).

Commands often consist of several command words; for example,

@ DEVICE CODE ASCII

Such commands may be abbreviated; for example

@ D C A

The spaces are required: @ DCA is not a legal command. Upper and lower case letters may be freely intermixed.

An unusual variation in command format is to place a number between the @ and the first word of the command. In this case, the command is not meant for the terminal typing but for the terminal attached to the port of that number on the same TIP as the user. This feature is described in some detail in the section on unusual uses of the TIP, section 5.

4. TYPICAL USE OF THE TIP

In the normal course of things, a user will go through four more or less distinct stages in typing into the net. First, he will be concerned with hardware-power, dialing in, etc. Then he will establish a dialogue with the TIP to get a comfortable set of parameters for this usage. Next, he will instruct the TIP to open a connection to a remote Host; and finally, he will mostly ignore the TIP as he talks to the remote Host. The following sections will describe these stages in more detail.

E. Connection Loss and Restoration

Starting with TENEX Hosts* running Software Version 1.32, if TENEX halts, the TIP will notify users connected to it of this fact by typing "Connection Suspended". At this point the users are free to do one of two things. First, they can wait till TENEX restores service, in which case the TIP will type out "Connection Restored" (or if after the the service interruption the connection could not be restored, the TIP will type out "Host broke the connection"). Alternatively, the user is free to open a connection to any other Host, in which case the TIP will invisibly close the TENEX connection. It is also important to point out that if a user just leaves his terminal unattended across a TENEX service outage without releasing the connection (any network related command such as @H, @O, @N, @C will do the job) his job, directory, etc., are left at the mercy of anyone who acquires that terminal.

Other Hosts may also implement the mechanisms which will allow the suspension and restoration of connections.

F. TIP News and User Feedback

There is frequently information which the group developing and debugging the TIP system wishes to convey to TIP users. For instance, when a bug is detected, we may wish to warn users not to use a certain feature until the bug is fixed. When a minor improvement is made, we may wish to notify users. Further, there is frequently news about the state of the network or the state of a particular Host which should be conveyed to TIP users. Finally, TIP users may wish to communicate with the TIP development staff or the Network Control Center staff about problems or suggested improvements for the TIP or the network. Consequently, we have constructed a mechanism which we hope will provide for communication in all the above directions. This mechanism is the Network Virtual TIP Executive.* To activate this mechanism, the TIP user may give the TIP command @N. This command causes the TIP to perform the necessary protocol to make a connection to the Network Virtual TIP Executive which resides on several of the network TENEX systems. Once the Network Virtual TIP Executive has been activated, we think its operation is self-explanatory. Presently available features within the Network Virtual TIP Executive are a Network News feature, a Host Status feature, and a "Gripe" feature. The latter provides users with a mechanism for sending messages to the TIP development or NCC staffs. We recommend that TIP users get the network news at the beginning of every TIP session.

The TIP will normally prompt the user to consider reading the news by typing the message:

Latest net news DATE
Use "@N<cr>" followed by "netnews<cr>"

at some point(s) during the user's session. The point chosen is at the time of terminal recognition for "hunting" terminals (see Section 4.A), or at each time a connection is closed for "non-hunting" terminals (see Section 5.A).

When a user issues an @N command, the TIP requests support from all cooperating servers. Thus, the user should be able to reach a news facility, somewhere, almost all of the time. However, in the event that no cooperating server is available the TIP will time out the @N command in about thirty seconds. An @C command will abort an @N immediately.

Of course, TIP users with an immediate need for communication with the NCC or TIP development staffs should telephone (collect) the Network Control Center (617-661-0100). Users with general questions

*A version of the Resource Sharing Executive being developed by the BBN TENEX Group.

about network usage (How do I find out if Host X is ever going to be up again? What's happening with a Host/Host protocol for graphics?) may also call the NCC.

5. UNUSUAL USES OF THE TIP

The "usual" use of a TIP is to connect one of the terminals which the TIP supports to a remote Host. We have tried to make this operation as easy and natural as possible for the user. "Unusual" uses of the TIP are such things as connecting a non-standard terminal, talking terminal-to-terminal, or using unusual protocols. Such uses are possible, but within the constraints of the TIP's size it has not always been feasible to make them easy.

C. Binary Mode

Seven-bit binary is possible using the regular TELNET Protocol. It is necessary to turn on and off command interpretation to allow the TIP input routines to pass along all 128 possible input characters. There are two commands to do this,

```
@ INTERCEPT ESC
@ INTERCEPT NONE
```

The first command puts the TIP in its normal mode, the second in 7-bit binary mode.

Eight-bit binary mode is possible using the commands

```
@ BINARY INPUT START
@ BINARY INPUT END
@ BINARY OUTPUT START
@ BINARY OUTPUT END
```

When a TIP is in binary output mode, all eight bits of characters coming from the network are sent to the terminal. This may result in strange things being printed on a printer. It would probably make more sense to send 8-bit binary output to devices such as paper tape punches. When a TIP is in binary input mode, all eight bits of characters entered at the terminal are sent to the network.

Since commands from a terminal in binary input mode or INTERCEPT NONE mode can no longer be recognized, removing a terminal from these modes must be done with a command from another terminal as described immediately below. As the TIP's default mode is INSERT LINEFEED, the user will probably desire to CLEAR INSERT LINEFEED (@C I L) before using 8-bit binary mode; perhaps also for 7-bit binary mode.

D. Setting Another Terminal's Parameters

Any command may be preceded by a number, in which case it is meant for a device other than your own. The device port number must be in octal. For example,

@ 16 DEVICE RATE 633

would set the characteristics for device 16 to ASCII code, 2400 baud input and output. In this case we speak of "capturing" device 16.

Such a mechanism needs some form of protection: the TIP remembers the number of the capturing device and does not allow a second device also to capture until the first device explicitly gives up control with the command

@ 16 GIVE BACK

If a device chooses to capture himself by preceding any command by his own device number he is then invulnerable to tampering from another device.

This format is usually used in conjunction with the DEVICE RATE command to initialize some non-standard device, like a printer or a high-speed CRT terminal.

E. The DIVERT OUTPUT Command

It is possible (with some care) to divert the output intended for one terminal to another terminal. Presumably the second terminal has a desired feature, like hard copy or high speed. The command

@ 16 DIVERT OUTPUT

will cause all remotely generated output to be diverted from the terminal on which the command was typed to Terminal 16. This state will continue until any other command is executed at the diverting terminal. (Executing another command does not do a Give Back.) Local-echoing will not be diverted, and input may proceed at the diverting terminal.

This mechanism is not natural to the structure of the program. In particular, the buffer allocation structure becomes confused if the diversion aborts while output is in progress. Chained diversion will also confuse the TIP. Please don't try these things: all that will happen is that one or both terminals involved will stop responding. In fact, in general, we discourage use of the DIVERT OUTPUT command and suggest printing to TIP devices other than the user's own terminal by programs such as the TIPCOPY program which runs on many network TENEXs.

F. Editing

At the moment the only editing command available is

@ FLUSH

which deletes all the characters in the TIP's input buffer. In current practice this command is used to clear out any odd characters stuck in a TIP prior to giving an OPEN command. (The TIP accumulates characters typed in during periods of non-connection and sends them as the first data over a new connection.)

To abort a command, type a rubout or merely make something about the command illegal; for example,

@O X

The "X" aborts the OPEN command.

G. Wild

Setting a device wild allows the device to receive any connection from a designated Host or to receive any connection from any Host. TIP ports cannot be set permanently wild from other TIP ports, they must be set wild by the NCC. The command to set a port wild is

```
@SET DEVICE WILD
```

This instructs the TIP to accept an attempt to connect from any Host using any sockets. This command can be cancelled by the command

```
@CLEAR DEVICE WILD
```

If a user desires to accept an attempt to connect from a particular Host using any sockets the set of commands

```
@HOST #
@SEND TO WILD
@RECEIVE FROM WILD
```

should be used. This instructs the TIP to accept any attempt to connect from the Host whose decimal address is specified in the Host command.

H. Low Level Protocol Commands

Several low level TIP commands exist which allow the user to manually do Host/Host protocol. These commands are

```
@ INITIAL CONNECTION PROTOCOL
@ PROTOCOL BOTH
@ CLOSE
@ PROTOCOL TO TRANSMIT
@ PROTOCOL TO RECEIVE
@ RECEIVE FROM HOST #
@ SEND TO HOST #
@ HOST #
@ SEND TO SOCKET #
@ RECEIVE FROM SOCKET #
```

Examples of the use of some of these commands are given below.

```
@H 69       /"logging in" to a socket
@R F S 13 /other than socket 1
@I C P      /on a server Host


@C          /attempt to close both halves of
            /an open connection
Closed R    /closed R side of connection
Closed T    /closed T side of connection
```

The rest of the low level protocol commands listed above were used in the example of section 5-B.

There is one other low level protocol command, a command to reset the NCP in the Host specified in a @ SEND TO HOST command. Since this command resets all connections between the TIP and the specified Host, it should only be used as a last resort. A responsible person at the TIP site should contact the NCC if the need arises.

The commands: @ R F H, @ S T H and @ H all require a Host address parameter. Currently, that parameter is a single decimal number. Additionally, the TIP will accept a two number Host address as follows.

<Host # on the IMP>/<IMP #>

Leading zeroes are not required. Therefore, for example, @ HOST 44, @ HOST Ø/44, or @ HOST /44 are all identical.